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Contribution from the Bureau of Biological Survey
E. W. NELSON, Chief

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FOOD HABITS OF THE SWALLOWS

A FAMILY OF VALUABLE NATIVE BIRDS

By

F. E. L. BEAL, Assistant Biologist

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FOOD HABITS OF THE SWALLOWS, A FAMILY OF VALUABLE NATIVE BIRDS.

By F. E. L. Beal, *Assistant Biologist.*[1]

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FOOD HABITS OF THE SWALLOWS

The swallows are the light cavalry of the army of birds, ever on the move, always on the skirmish line, their wings tireless. From early dawn until night they forage the fields of air, constantly on the alert to cut off stragglers from insect camps and missing no opportunity to destroy these enemies of the farmer. From time immemorial these birds have been the friends and companions of man. Whenever he has had a literature it has recorded the praise of the swallow. Ever since the human race has had a history "the swallow twittering from the straw-built shed" has roused the peasant at break of day to resume his labors, and he has returned to his cabin to rest "when the swallows homeward fly."

All the species are more or less gregarious and appear to like not only the companionship of their kind but also that of man, to whom many have attached themselves, not as parasites but as cheerful companions and helpful friends. Probably no group of birds has made such a change in nesting sites as have some species of swallows, which persistently use the structures of man as a shelter and foundation for their nests instead of those provided by nature.

[1] Prof. Beal, the most experienced economic ornithologist in the country, died on October 1, 1916, shortly after the preparation of this paper.—Editor.

Note.—This bulletin is a technical study of the food habits of the seven North American forms of the swallow family. It is for distribution in all sections of the United States.

In their relations to man the swallows, as a group, are as harmless as any family in the bird kingdom, and yet they are more closely related to him socially than any other birds except domestic fowls. No complaint has ever been made that these birds harm either wild or cultivated fruit or seed or that they injure other birds. Although practically altogether insectivorous, they do not disturb domestic bees, and in a region where the silk-worm industry flourishes they would not harm the silkworms, for they do not eat Lepidoptera (caterpillars, moths, etc.) extensively, either larval or adult. The esteem in which swallows have always been held is well deserved. It is doubtful if there is a more useful family of birds in the world. Every provision should be made to induce them to stay about the farm or homestead.

Swallows are pronounced flycatchers in the sense that they catch their prey upon the wing. Their mouths are specially adapted to act as scoops and take in insects in the air. Probably no other family of land birds spends so many of the daylight hours upon the wing as the swallows. It would follow, therefore, that their food would be taken mostly in mid-air and that it would be limited to insects that fly or jump. This would eliminate from their dietary such forms as caterpillars and beetle larvæ and, in short, larvæ in general; also such creatures as millepeds, sowbugs, snails, and, to some extent, spiders, although these are able to fly under certain conditions by means of their webs.

That insects which spend most of their time in flight constitute the principal items of the swallow's food is verified by the examination of 2,030 stomachs. This shows that Hymenoptera (bees, wasps, and ants) and Diptera (flies) constitute more than 50 per cent of the average food of the seven North American species here treated (see tabular summary, p. 28). Hemiptera (bugs, cicades, tree hoppers, etc.) stand next in importance, although the species in general are not such good flyers and do not spend so much time on the wing as the Hymenoptera. The three insect orders, Hymenoptera, Hemiptera, and Diptera, constitute nearly 70 per cent of the average food of the swallows of the United States. Coleoptera (beetles) are less given to flying, and consequently are not so often taken, the small dung beetles (*Aphodius*) that fly over cow droppings in the evening being most commonly eaten. As all swallows apparently prefer to forage over the surface of still water, they take in their food such insects as aquatic Hemiptera and dragonflies, with other aquatic forms.

The swallow's habit of taking its prey upon the wing and its reluctance to alight upon the ground tend to exclude from its food all vegetable matter as well as nonflying insects. Stomach examination, while confirming this as a general rule, shows some exceptions. The

tree swallow, for instance, eats a notable quantity of vegetable food, and nearly all the species contrive to get a few caterpillars or other wingless prey, and take at least a taste of Orthoptera (grasshoppers, crickets, etc.).

There are within the limits of the United States 13 species of swallows, of which the following seven are of such wide distribution as to render their food habits a subject of economic interest: Purple martin (*Progne subis*); cliff, or eaves, swallow (*Petrochelidon lunifrons*); barn swallow (*Hirundo erythrogastra*); tree, or white-bellied, swallow (*Iridoprocne bicolor*); violet-green swallow (*Tachycineta thalassina*); bank swallow (*Riparia riparia*); and rough-winged swallow (*Stelgidopteryx serripennis*). The food of these seven species is discussed in the following pages.

PURPLE MARTIN.

Progne subis.

The purple martin (Pl. I, upper figure) occurs in nearly all parts of the United States where suitable nesting sites are found. As its nest is usually in a cranny of a building or in a house put up for its express use, it follows that the bird breeds chiefly in settled portions of the country. Probably at one time it nested in holes in cliffs, but that time is long past, and now, showing the greatest confidence in its human neighbors, the bird builds its nest as readily in the midst of a noisy city as about a country cottage or on a quiet farm.

For the determination of the food of the martin 205 stomachs were available, collected throughout the United States with a few from Canada. They represent the months from February to September, inclusive, and are fairly well distributed through that period. Examination shows that the food consists entirely of animal matter, insects with a few spiders and other allied creatures, with no trace of vegetable food. The largest item consists of Hymenoptera (23 per cent). These were found in 129 stomachs, of which 7 contained no other food. Ants (3.52 per cent) were found in 30 of these and formed the sole contents of 2. As many ants have no wings, they are probably snapped from the tops of weeds as the martin darts past. Occasionally, however, the bird had evidently met a swarm of winged ants and made nearly a full meal of them. Among the Hymenoptera were some useful parasitic species. Ants, on the contrary, are annoying if not harmful, so that while the bird's consumption of Hymenoptera is on the whole not a decidedly good function, it certainly results in little or no harm. Five stomachs contained remains of honey bees (*Apis mellifera*) with an aggregate of 11 individuals, all of them males, or drones.

Diptera, found in 50 stomachs and forming the sole contents of 7, stand next in the food of the martin. Eaten in every month in which stomachs were taken, they amount to 16.09 per cent of the food. They consisted largely of the long-legged tipulids, better known as daddy longlegs, whose larvæ are destructive to the roots of grass. Besides these, many of the Muscidæ, the family of the common house fly, were eaten, and a few specimens of robberflies (Asilidæ) were found. The latter are predacious insects and are said to be very destructive to bees.

Hemiptera, found in 70 stomachs, amount to 14.58 per cent of the food. They belong to several families, among the most abundant of which are the Pentatomidæ (stinkbugs), the Membracidæ (tree hoppers), and the Thyreocoridæ (negro bugs). The notorious squash bug (*Anasa tristis*) was found in 1 stomach. One stomach contained 26 specimens of *Nezara hilaris*, a pentatomid; others contained, respectively, 27, 25, 11, and 8 individuals of *Myodocha serripes;* and several others a less number. This shows how freely these bugs are eaten by the martin. *Leptoglossus oppositus* and *Metapodius femoratus*, large bugs that do much damage to plants and fruit, were found in two stomachs.

Coleoptera, the insects next in order of abundance, amount to 12.53 per cent of the food. Of these, 1.28 per cent were useful beetles, mostly Carabidæ, or ground beetles, with a few tiger beetles. The remainder belong to more or less harmful species. The Scarabæidæ, or May-beetle family (5.21 per cent), were found in 47 stomachs and are apparently the favorites. Many of them were small dung beetles (*Aphodius*), which hover over cow droppings in the early evening and so are easily captured by martins. One stomach contained 75 individuals of a single species, and another 35. Some of the larger flower beetles (*Euphoria*) also were taken, one form of which *E. inda*, often destructive to fruit, was found in 6 stomachs. One stomach contained 100 individuals of another small species of this family (*Strigoderma pygmæa*).

Among the most interesting beetles found in the stomachs were the Rhynchophora, or snout beetles. This group, commonly known as weevils, includes some of the most destructive species known. The cotton boll weevil (*Anthonomus grandis*) was found in two stomachs. The clover weevil (*Hypera punctata*) was found in nine stomachs, one of which contained 20, and others 17, 12, and 9 of these destructive insects. Insects of the genus *Balaninus*, which bore into and destroy nuts and large seeds, were found in 14 stomachs. The genus *Sitona* in several of its species is destructive to clover and allied plants; in one martin's stomach were found 53 individuals of the species *S. hispidula* and in another 16; in a third stomach were 27 specimens of *S. flavescens*, also a pest. The strawberry

PURPLE MARTIN (UPPER), BARN SWALLOW (MIDDLE), AND CLIFF SWALLOW (LOWER).

weevil (*Otiorhynchus ovatus*) occurred in one stomach. *Tomicus calligraphus*, one of the engraver beetles that work under the bark of trees, also was found in one stomach. In all, weevils of different species were found in 48 stomachs. Sundry other beetles, of more or less economic interest, made up 3.41 per cent of the food.

Lepidoptera usually appear in the stomachs of birds in the larval form—that is, as caterpillars—but as birds that take their prey upon the wing are not likely to capture caterpillars, this item of food with the swallows is usually composed of remains of adult insects. It amounts to 9.39 per cent of the food of the martin, and is mostly taken at the end of the season; that is, in August and September. None were taken in February and March, and for some unknown reason none were eaten in June. Small moths were found in 39 stomachs, and a butterfly (*Vanessa atalanta*) in 1. It is possible that there were more butterflies which could not be identified. Moths formed the sole contents of 11 stomachs, and in one 12 heads were counted. The distribution of this item of food through the season is very curious and not readily explainable. Over 93 per cent of it is eaten in August and September, with but little in any other month.

Orthoptera are eaten sparingly by the martin. Their total in the yearly food of the martin is only 1.09 per cent.

Dragonflies appear to be a favorite food of the martin. They were eaten every month except February and were contained in 65 stomachs, of which 7 held nothing else. Many were of the larger species, seemingly rather large morsels for the bird. The total for the season is 15.1 per cent of the food, a percentage unusually large for these insects and indicating that the martin hunts especially for them. The bank swallow is the only other species that eats enough dragonflies to warrant a separate record. Adult dragonflies live by killing other insects and thus are usually reckoned as useful creatures, but the young feed to some extent upon small fishes and do some harm in this way. Their destruction, therefore, may be regarded as having a neutral effect. Aquatic in their larval stage, dragonflies naturally stay about water or wet places, and as martins are likely to nest at a distance from water, to get them the birds must go to the haunts of the insects.

A few other insects, mostly Ephemeridæ, with a few spiders and sowbugs (8.09 per cent), complete the food. A bit of mollusk shell and a vertebra of a fish are among the curiosities noted.

Summary.—While in its food habits the martin does not inflict the direct injury upon man that the bird that preys upon his fruit does, yet it must be admitted that in its animal food in theory it does some harm. Among the Hymenoptera eaten are many parasitic species, all reckoned as useful insects, and the whole order are cer-

tainly useful in fertilizing flowers of plants. In many cases this function is essential, and without this intervention of insects many species of plants would become extinct. On the other hand, there is no evidence that plants suffer in any way from lack of insect service, and it is probable that in this one respect the balance in nature is nearly perfect and not likely to be disturbed by any increase of birds or corresponding decrease of insects. The martin may safely be protected and encouraged.

Following is a list of the insects identified in stomachs of purple martins and number of stomachs in which found:

ODONATA.	
Libellula sp	1
ORTHOPTERA.	
Tettix sp	5
HEMIPTERA.	
Cicada sp	3
Telamona sp	1
Platycotis sp	1
Micrutalis calva	1
Podisus subspinosus	1
Euschistus inflatus	1
Solubea pugnax	1
Nezara hilaris	1
Leptoglossus oppositus	2
Metapodius femoratus	1
Anasa tristis	1
Myodocha serripes	9
Gerris sp	2
LEPIDOPTERA.	
Vanessa atalanta	1
COLEOPTERA.	
Cicindela sp	1
Lebia sp	1
Anisodactylus baltimorensis	1
Rhantus bistriatus	1
Tropisternus sp	1
Cercyon ocellatus	1
Creophilus villosus	2
Philonthus sp	1
Hister abbreviatus	1
Hister civilis	1
Glischrochilus fasciatus	9
Trogosita virescens	1
Buprestis lineata	1
Canthon sp	1
Onthophagus sp	1
COLEOPTERA—continued.	
Aphodius fimetarius	20
Aphodius inguinatus	19
Aphodius stercorosus	1
Aphodius sp	3
Dichelonycha sp	3
Strigoderma pygmæa	2
Euphoria inda	6
Criocephalus sp	1
Typophorus vittatus	1
Colaspis brunnea	2
Mylabris prosopis (Bruchus)	1
Serropalpus barbatus	1
Otiorhynchus ovatus	1
Sitona hispidula	3
Sitona flavescens	2
Sitona sp	4
Hypera punctata	9
Endalus æratus	1
Anthonomus grandis	2
Tylopterus pallidus	1
Balaninus nasicus	1
Balaninus sp	13
Sphenophorus pontederiæ	1
Sphenophorus callosus	1
Sphenophorus sp	1
Platypus flavicornis	2
Xyleborus impressus	1
Tomicus calligraphus	1
Chramesus icoriæ	1
HYMENOPTERA.	
Apis mellifera	5
Chrysis sp	1
Tiphia inornata	1
Scambus sp	1
Ichneumon irritator	1
Chalcis sp	1
Pogonomyrmex sp	1

CLIFF, OR EAVES, SWALLOW.

Petrochelidon lunifrons.

The cliff, or eaves, swallow (Pl. I, lower figure) is found locally throughout the United States. Its former and natural nesting site was under an overhanging bank of earth, as along a stream or under a cliff. Now the favorite spot for its nest is under the eaves of a building or occasionally under a roof if there is free

access to it, as in an open shed; for the eaves swallow does not like to go through a small hole to get to its nest as does the barn swallow. In the far West it may still be found nesting in the old-fashioned way, but where suitable buildings have been put up, this species has not been slow to avail itself of the safer and more sheltered site. Unfortunately, some people consider the nests of this swallow a disfigurement to the building on which they are placed. Were the nests attached to the front of a handsomely finished house, some complaint might justly be made, but smoothly finished and painted buildings are not what the bird requires. A roughly finished barn or other outbuilding or a brick structure to which the mud used in building will adhere, is more satisfactory and is usually chosen. Nests on an outside location are usually bottle-shaped and made of mud worked into pellets in the mouths of the builders. Probably these birds, like the swifts, are able to add to this mud some adhesive substance from their mouths which makes it adhere more firmly to the wall on which it is placed.

For the study of the food of the eaves swallow 375 stomachs were available, taken in every month from March to September and giving a fair representation of the food in each of these months, except March, in which only one stomach was taken. While the food consisted almost entirely of animal matter, a small portion (0.66 per cent) of vegetable matter was found in several stomachs, much of it being mere rubbish, but some recognizable as food material. As it has very little interest, either economic or academic, it may as well be disposed of forthwith. None was found in March or September, but scattering along through the other months were pieces of seeds and rubbish mostly taken accidentally with other food. Two stomachs, taken in May in Texas, were entirely filled with fruit of *Juniperus monosperma*, which was undoubtedly taken intentionally as food. This seems to show that the bird can at times subsist upon vegetable matter.

The animal food consists of insects, with a few spiders. Beetles are the largest item but one, and amount to 26.88 per cent. Of these 2.67 per cent are useful species, mostly ladybirds (Coccinellidæ), which are good fliers and so fall in the swallow's way. The predacious ground beetles, eaten by so many birds, do not form an important part of the swallow's food, as they are not generally much on the wing. Members of the May-beetle family (Scarabæidæ) amount to 4.97 per cent. They consist mostly of the small dung beetles (*Aphodius* and *Atænius*) which are easily taken on the wing as they fly in swarms near the ground. A few of the larger species also were eaten, but most of them are too large for the swallow to manage.

The snout beetles, or weevils (Rhynchophora), are the most interesting insects eaten. They were taken nearly every month in fair quantities, but in September they constituted over 50 per cent of the food. This record, however, is probably due to the fact that special pains were taken during this month to collect birds in a locality specially infested by one species of weevil. In order to ascertain to what extent birds were preying upon the cotton boll weevil (*Anthonomus grandis*) 35 stomachs of the eaves swallow were collected in September in the vicinity of cotton fields in Texas. Every one of these stomachs contained boll weevils, and several contained other species also. Of the boll weevils 687 individuals were counted, an average of over 19 to each stomach, and it is probable that more were really present but being badly broken up could not be recognized. Let it be noted that these are not selected stomachs, but embrace every one of this species taken at that time and place. One of these contained 48 weevils, another 42, two contained 38 each, and three others 37, 35, and 33, respectively. Two stomachs taken at another time in Mississippi revealed 11 of these weevils. From the above facts it is evident that these birds were taking every one of these insects that came in their way and probably were making a special hunt for them.

The eaves swallow is particularly gregarious and lives in colonies that sometimes contain several hundred individuals. The writer has seen a colony of 80 nests, and larger ones have been observed. It is thus evident that such a colony in the near vicinity of an infested cotton field would have a very decided effect in restraining the increase of this pest. As the weevils are taken when in flight, it follows that migration to other fields would be largely prevented. Besides the boll weevils, 15 other species of snout beetles were eaten. All are harmful insects and liable at any time by some change in environment to become pests. The alfalfa weevil (*Phytonomus posticus*) was found in 11 stomachs taken in Utah. This is a recently imported pest and is doing much damage in the far West. Two species of weevils, *Sitona flavescens* and *Sphenophorus parvulus*, the one doing great damage to clover and the other feeding upon grass and grain, were found in several stomachs. The rice weevil (*Calandra oryza*), which does not confine its diet to rice, had been eaten by 5 birds.

Besides the weevils, a number of other beetles more or less harmful were eaten, 113 species being identified in the stomachs.

Hymenoptera exclusive of ants (8.24 per cent) amount to 20.51 per cent. Ants, mostly the winged forms, were eaten in every month except March. The month of greatest consumption (nearly 20 per cent) was September. Other Hymenoptera eaten are mostly wild bees and wasps, with some parasitic species. The remains of 35 honey

bees (*Apis mellifera*) were identified in 13 stomachs. More were probably present but unidentifiable. All were males, or drones. To what extent birds select their food has long been a matter of conjecture. When it is considered that the worker bees in the hive far outnumber the drones, it is evident that the foraging birds must meet many workers where they encounter a single drone. Evidently the drones are deliberately selected by the eaves swallow, for not a trace of a worker bee was found in any stomach.

Hemiptera in various forms in the food of this bird amount to 26.32 per cent. They belong to 11 families, chiefly the Capsidæ, Lygæidæ, Coreidæ, Pentatomidæ, and Jassidæ, which are probably the best flyers. While the great majority are harmful insects, the most interesting is the well-known chinch bug (*Blissus leucopterus*), which is said to cause a loss in the wheat crop of millions of dollars in years favorable to the insect's development. It was found in the stomachs of 6 eaves swallows, and 29 individuals were identified, but in one stomach, where only two entire specimens could be made out, the fragments of not less than 100 were plainly identified, and it is probable that the few here recorded are really the representatives of hundreds—perhaps thousands—that the birds had taken.

Diptera were eaten by the eaves swallow to the extent of 13.95 per cent. None were taken in March, but a fair percentage was recorded for each of the other months, the most being eaten in April (35.22 per cent). Few were identified further than as to family. Golden-green fleshflies were present in large numbers, together with many small soft midges not further identifiable. Craneflies, which are eaten by so many species of birds, were not found in the stomachs of these swallows.

Lepidoptera form an unimportant part of the cliff swallow's diet. Apparently but few birds are fond of adult butterflies or moths, though they may greatly relish their larvæ—caterpillars. While swallows seldom come in contact with caterpillars, one or two were identified, probably picked from the top of a weed or shrub as the bird sped past. A few moths made up the bulk of the lepidopterous food of the cliff swallow, 0.46 per cent for the year and 1.11 per cent for April; the month of maximum consumption.

Orthoptera, like moths and butterflies, are but lightly regarded by the cliff swallow. Of the year's food they constitute only 0.71 per cent, and in July, the month of greatest consumption, only 2.06 per cent. None were taken in March, April, or August, the last, with most insectivorous birds, the chief grasshopper month. The large size of many grasshoppers probably saves them from the swallows, for many are extensive fliers. Again, birds that eat grasshoppers usually take them to the ground, a branch of a tree, or the top of a fence, where they hammer them to fragments small enough

to be swallowed easily. This is manifestly impossible for the birds of this family, as their bills are weak and they do not perch on the ground or other places where they can beat their prey as do other birds.

A few other insects, as dragonflies, May flies, and lace-winged flies, several spiders, a snail, and a few bits of eggshell (collectively, 2.97 per cent) close the food account. That eggshells and snails should be taken by birds that so seldom alight upon the ground may seem a little curious, but as they come to the earth in order to get mud for their nests, they may possibly do so at other times. There were in the stomachs several gravel stones and one or two pieces of old mollusk shell, which, like the snail shell, must have been picked up from the ground.

Summary.—The food of the cliff swallow contains few elements that can be criticized from an economic point of view. The destruction of a few coccinellid beetles and some parasitic hymenopterans is theoretically harmful to the interests of man, but practically it has little effect. The bird does no direct injury, and it consumes many noxious insects, notably two of the most destructive pests that the country has ever known—the chinch bug and the boll weevil. In view of this record it is hoped that the practice of tearing down its nests will be discontinued. Cliff, or eaves, swallows should be protected and encouraged in every way. The belief that they harbor bedbugs in their nests is erroneous. Their parasites are of a different species from the one that afflicts mankind.

Following is a list of insects found in stomachs of cliff swallows and the number of stomachs in which found:

HEMIPTERA.	
Entylia concisa	1
Stictocephala festiva	2
Clastoptera obtusa	1
Agallia 4-punctata	1
Deltocephalus sp	1
Eucanthus sp	1
Homalodisca sp	1
Hymenarcys nervosa	1
Nezara hilaris	1
Emesa sp	1
Sinea diadema	1
Sinea sp	1
Reduviolus sp	1
Blissus leucopterus	6
Perigenes sp	2
Salda sp	1
ORTHOPTERA.	
Tettix sp	2
Ceuthophilus sp	1
COLEOPTERA.	
Elaphrus ruscarius	4
Elaphrus sp	1
Dyschirius marinus	1
COLEOPTERA—continued.	
Pterostichus lucublandus	1
Pterostichus scitulus	1
Pterostichus sp	1
Amara fallax	1
Amara sp	2
Agonoderus pallipes	1
Selenophorus sp	1
Anisodactylus baltimorensis	2
Brychius sp	1
Cnemidotus callosus	1
Cœlambus patruelis	1
Helophorus lineatus	21
Helophorus sp	1
Octhebius puncticollis	1
Tropisternus limbalis	1
Laccobius agilis	2
Laccobius ellipticus	1
Philhydrus hamiltoni	1
Cercyon prætextatum	1
Cercyon sp	1
Megasternum sp	1
Cryptopleurum minutum	4
Heterocerus sp	2
Philonthus varians	1
Philonthus lomatus	1

COLEOPTERA—continued.

Philonthus sp	1
Tachyporus californicus	1
Megilla maculata	14
Hippodamia ambigua	3
Hippodamia 15-maculata	1
Hippodamia convergens	16
Hippodamia 13-punctata	3
Hippodamia parenthesis	1
Hippodamia sp	1
Coccinella sanguinea	2
Coccinella californica	2
Hyperaspis fimbriata	1
Scymnus collaris	2
Scymnus partibus	1
Scymnus loewii	3
Scymnus marginicollis	1
Scymnus sp	3
Typhæa fumata	1
Dermestes mannerheimii	1
Hister sellatus	1
Hister interruptus	1
Hister abbreviatus	1
Hister curtatus	1
Hister americanus	2
Hister subrotundus	4
Saprinus insertus	1
Pachylophus æneipunctatus	2
Cercus sericans	1
Glischrochilus fasciatus	12
Melanophthalmus gibbosus	1
Limnichus punctatus	2
Dryops striata	1
Chauliognathus marginatus	36
Chauliognathus sp	1
Onthophagus tuberculifrons	1
Onthophagus pennsylvanicus	2
Onthophagus sp	6
Atænius sp	1
Aphodius fimetarius	61
Aphodius granarius	3
Aphodius vittatus	5
Aphodius lividus	1
Aphodius inquinatus	16
Aphodius sp	40
Strigoderma pygmæa	3
Callidium antennatum	1
Hæmonia nigricornis	7
Lema trilineata	2
Chlamys sp	1
Diachus auratus	3
Myochrous denticollis	6
Typophorus viridicyaneus	1
Typophorus sellatus	7
Colaspis sp	1

COLEOPTERA—continued.

Plagiodera prasinella	1
Gastroidea polygoni	1
Gastroidea viridula	1
Gastroidea cyanea var. *cæsia*	2
Lina scripta	11
Cerotoma trifurcata	2
Diabrotica 12-punctata	4
Diabrotica soror	5
Diabrotica sp	1
Epitrix parvula	2
Epitrix sp	1
Longitarsus melanurus	2
Gliptina atriventris	2
Chætocnema pulicaria	5
Psylliodes punctulata	1
Mylabris amicus (*Bruchus*)	2
Notoxus sp	4
Anthicus sp	1
Sitona flavescens	2
Sitona sp	12
Apion vespertinum	1
Apion cavifrons	1
Apion sp	1
Phytonomus posticus	13
Anthonomus grandis	37
Anthonomus eugenii	1
Rhinoncus pyrrhopus	2
Baris confinis	1
Balaninus sp	15
Sphenophorus placidus	1
Sphenophorus parvulus	1
Sphenophorus sp	1
Calandra oryza	5
Platypus flavicornis	1
Tomicus pini	1
Hylastes sp	1
Brachytarsus variegatus	1

DIPTERA.

Lucilia sp	2
Fannia canicularis	1

HYMENOPTERA.

Apis mellifera	13
Tiphia sp	1
Formica sp	1
Ponera coarctata pennsylvanica	2
Tapinoma sessile	1
Lasius alienus	1
Lasius sp	5
Ichneumon sp	1
Urosigalphus sp	1
Apanteles sp	1

BARN SWALLOW.

Hirundo erythrogastra.

The barn swallow (Pl. I, middle figure) occurs in nearly the whole country where suitable buildings for its occupancy can be found, but on the Pacific side of the continent it still largely frequents its original nesting sites in caves and holes in cliffs. That it is ready at

any time to give up the old-fashioned homestead for one provided by man is shown, however, in all well-settled localities of the far West. There it avails itself of barns, sheds, and bridges, as it has long done in the East, where its right to a nesting place among the rafters is so well established that when new barns are built a hole is frequently made up near the peak of the gable for the birds to pass easily in and out.

The food of the barn swallow, like that of its allies, consists almost wholly of insects, with an occasional spider or snail. A few bits of vegetable matter are taken accidentally—that is, snatched from the top of a weed or shrub with an insect taken as the bird dashes past. Occasionally a berry or seed is eaten intentionally. Ordinarily all food is taken on the wing, but snails have been picked up, probably when the bird was getting mud for its nest.

For the investigation of the food of this swallow 467 stomachs were available, collected in the months from March to October, in 27 States, the District of Columbia, and Canada. The first analysis shows that the food is made up of 99.82 per cent animal matter to 0.18 vegetable. The latter is considerably less than that eaten by the cliff swallow. All the vegetable matter found was contained in six stomachs, but it was real food in only four. One of these revealed seeds of the elderberry (*Sambucus*) and of *Cornus sericea*. Vegetable food in this stomach made up 75 per cent of the contents. The second stomach held a single kernel of buckwheat, the third a root or bulb, and the fourth two seeds of *Croton texensis*. Having taken so little vegetable food, it seems curious that the bird should have eaten any at all.

Of the animal food beetles of various families amount to 15.63 per cent. Useful species, that is, those that prey upon other insects, as the predacious ground beetles (Carabidæ) and the ladybirds (Coccinellidæ), amount to 3.4 per cent. The May-beetle family (Scarabæidæ), apparently the most palatable, are eaten to the extent of 6.2 per cent. These are mostly small dung beetles of various species of the genus *Aphodius*. One stomach was noted as containing 50 or more, and another, several hundred. Snout beetles, or weevils (1.96 per cent) include a variety of species. First in interest is the cotton boll weevil (*Anthonomus grandis*), found in 12 stomachs, with an average of somewhat more than 6 individuals each. Next in interest is the rice weevil (*Calandra oryza*), which was identified in 8 stomachs, with 153 individuals in one, 50 in another, and from 15 to 20 in a third. Two species of the genus *Sitona* were found, *S. flavescens* and *S. hispidula*, both very destructive to forage crops. Among other weevils were two of the destructive engraver beetles that do so much damage to timber. In all, about 80 species of beetles

were identified in the stomachs, most of them harmful and some exceedingly so.

Ants are eaten by the barn swallow to the extent of 9.89 per cent of the food, some stomachs being entirely filled with wingless species. These were found in 124 stomachs, and in 14 there was no other food. Most of them were of rather large size as compared with those taken by the flicker and other ground-feeding birds. One stomach, however, contained approximately 1,000 small individuals. Another contained between 300 and 400 of the ant *Solenopsis molesta*, a small species. Hymenoptera other than ants (12.82 per cent) were found in 254 stomachs and are evidently a favorite food of this swallow. Besides the common bees and wasps were many parasitic forms. One male, or drone, honey bee was found.

Hemiptera formed 15.1 per cent and from the regularity with which they occur in the food are evidently very palatable. They were found in 192 stomachs, and 16 families were identified. Of these the most important are the Pentatomidæ, or stinkbugs; Jassidæ, or leaf hoppers, of which one stomach was estimated to contain at least 1,000; Capsidæ, or leaf bugs, contained in 48 stomachs; Aphididæ, or plant lice; and Lygæidæ, which are represented by the notorious chinch bug (*Blissus leucopterus*), found in 7 stomachs. This last pest is too well known to require comment. It is well to know its enemies.

Diptera are evidently the choice food of the barn swallow. They average 39.49 per cent of the food, or more than twice that of any other order of insect, and nearly two-fifths of the whole. They were contained in 338 stomachs, or nearly three-fourths of all, and 33 contained no other food. In March they constitute 82 per cent of the food, and in September, the month of least consumption, nearly 18 per cent. These insects are mostly allied to the common house fly, and were identified in 110 stomachs, but several other families are represented. Among them are the long-legged craneflies (Tipulidæ), a number of horseflies (Tabanidæ), and several robberflies (Asilidæ), which prey upon other insects and are said to be very destructive to honey bees. The consumption of flies by the barn swallow is, to say the least, interesting. It is greater than that of any of the flycatchers (Tyrannidæ) except one and is exceeded by only two other species of swallows. Only such birds as are very active on the wing can catch many flies. Thrushes and blackbirds get a few, but as a rule these are only the craneflies, which move sluggishly and breed in colonies where birds can easily reach them.

Lepidoptera are evidently not greatly relished by the barn swallow. The adult insects can hardly be considered a favorite food for any species of bird, as most of the lepidopterous food is eaten in the larval

state. Swallows can not easily avail themselves of this food, for caterpillars are not readily taken on the wing. All but one of the lepidopterans eaten by the barn swallow were taken in the adult state and amount to only 2.39 per cent of the food. Nearly all were secured in October, and in no other month did they form as much as 1 per cent.

Grasshoppers and crickets are a favorite food for many insectivorous birds and in many instances are evidently carefully sought after, but they form only 0.51 per cent of the food of this swallow. Grasshoppers are frequently upon the wing and will rise in front of one walking through grassy fields and often fly several rods. While not a general rule, some species are capable of making long-sustained flights. Flycatchers probably capture them in mid-air, and swallows might take them in the same way if they cared for them. The greatest consumption by this swallow (2.54 per cent) occurs in August.

Other insects of more or less importance serve to a certain extent as food for the barn swallow. These are dragonflies (4 per cent), found in 26 stomachs, May flies (Ephemerida) found in 13, spiders in 9, and snails in 9. Dragonflies, though large and conspicuous insects, are not taken by many birds, as they are very agile, but flycatchers and swallows seem to capture them easily.

Summary.—There seems to be little reason for criticizing the food of the barn swallow, as the bird eats neither fruit nor grain and does not injure the farmer's crops in any way. It feeds upon many injurious insects and destroys some of the worst of the farmer's pests. It is cheerful and companionable and a pleasant adjunct to rural life.

Following is a list of insects identified in stomachs of barn swallows and the number of stomachs in which found:

ORTHOPTERA.	
Conocephalus sp	2
HEMIPTERA.	
Ceresa bubalis	1
Entylia sinuata	1
Stictocephala lutea	1
Campylenchia curvata	1
Ophiderma sp	1
Thyreocoris pulicaria	1
Amnestus pusillus	1
Geotomus sp	1
Pangæus sp	1
Blissus leucopterus	7
Myodocha serripes	3
Sinea diadema	1
COLEOPTERA.	
Elaphrus ruscarius	1
Bembidium variegatum	1
Amara sp	2
Cnemidotus 12-punctatus	1
Cnemidotus sp	1
Helophorus lineatus	1
COLEOPTERA—continued.	
Sphæridium scarabæoides	1
Cryptopleurum minutum	4
Heterocerus tristis	1
Atheta sp	1
Philonthus hepaticus	1
Philonthus siegwaldi	1
Philonthus sp	1
Boletobius sp	1
Olophrum obtectum	1
Phalacrus penicillatus	1
Hippodamia convergens	2
Scymnus loewii	1
Scymnus sp	1
Aulonium sp	1
Dermestes fasciata	1
Dermestes sp	1
Hister abbreviatus	2
Hister bimaculatus	2
Hister americanus	2
Hister subrotundus	2
Dendrophilus punctulatus	1
Saprinus pennsylvanicus	2
Saprinus assimilis	2

COLEOPTERA—continued.

Saprinus æneicollis	2
Saprinus lubricus	1
Saprinus fimbriatus	1
Saprinus sphæroides	1
Carpophilus dimidiatus	1
Stelidota geminata	1
Glischrochilus fasciatus	10
Dryops striata	1
Cryptohypnus obliquatus	1
Agrilus sp	2
Onthophagus hecate	9
Onthophagus tuberculifrons	2
Onthophagus pennsylvanicus	32
Onthophagus sp	19
Atœnius cognatus	1
Aphodius fimetarius	43
Aphodius vittatus	3
Aphodius inquinatus	22
Aphodius prodromus	1
Aphodius sp	39
Dichelonycha sp	1
Strigoderma pygmæa	2
Hæmonia nigricornis	13
Cryptocephalus trivittatus	1
Cryptocephalus sp	2
Cerotoma trifurcata	3
Diabrotica soror	1
Haltica obliterata	1
Crepidodera helxenes	2
Crepidodera sp	1
Epitrix cucumeris	1
Epitrix parvula	1
Chætocnema pulicaria	1
Odontota dorsalis	1
Mylabris prosopis (*Bruchus*)	1
Notoxus alamedæ	2
Notoxus sp	3
Anthicus sp	1
Sitona hispidula	5
Sitona flavescens	2

COLEOPTERA—continued.

Sitona sp	8
Anthonomus grandis	12
Gymnetron teter	1
Baris sp	1
Trepobaris elongatus	1
Trichobaris texana	1
Centrinus picumnus	2
Limnobaris deplanata	1
Balaninus parvidens	1
Balaninus sp	4
Sphenophorus parvulus	1
Sphenophorus placidus	1
Sphenophorus sp	1
Calandra oryza	8
Tomicus cacographus	1
Tomicus pini	7
Hylastes sp	10
Brachytarsus variegatus	1

DIPTERA.

Chrysops sp	3
Parephydra humilis	1
Lucilia cæsar	2
Lucilia sp	3
Calliphora vomitoria	8
Stomoxys calcitrans	1

HYMENOPTERA.

Apis mellifera	1
Tiphia inornata	2
Tiphia sp	1
Solenopsis molesta	1
Myrmica scabrinodis	1
Aphenogaster fulva	3
Lasius sp	1
Formica fusca var. *neoclara*	1
Colpognathus sp	1
Ophion sp	4
Spilochalcis flavipes	1
Chalcis sp	1

TREE, OR WHITE-BELLIED, SWALLOW.

Iridoprocne bicolor.

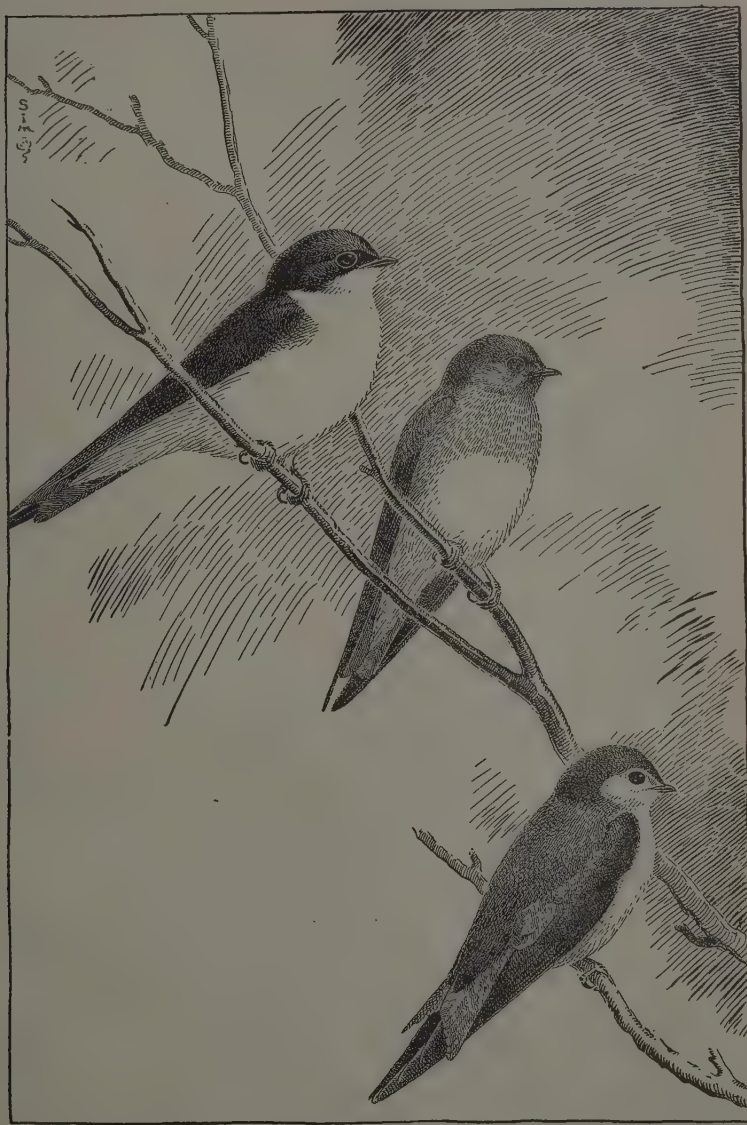
The tree, or white-bellied, swallow (Pl. II, upper figure), as it is variously called, is found all over the United States except in some desert or extensive treeless areas. In a state of nature this bird builds its nests in hollow branches or dead trunks of trees, and to-day may occasionally be seen occupying one of its original haunts. Boxes put up for wrens and bluebirds seem to suit the tree swallow exactly, and when available these are taken in preference to the hollow branch.

In its food habits this species differs somewhat from other American swallows in that it eats an appreciable quantity of vegetable food, frequently filling its stomach completely with berries or seeds. To determine the extent of this difference, 343 stomachs were examined, collected in every month of the year in 22 States, British

Columbia, Ontario, and New Brunswick, and fairly well representing the region from Maine to California and from Canada to Florida. Of these 80 contained vegetable food and 35 contained nothing else. In the first analysis the food divided into 80.54 per cent animal matter to 19.46 per cent vegetable.

The vegetable food is made up of a few varieties of seeds and berries, but more than nine-tenths of it consists of the fruit of a single shrub, the bayberry, or waxberry (*Myrica carolinensis*). The fruit of this plant consists of small, dry, hard seeds overlaid with a covering of small, irregular black granules, like old-fashioned gunpowder, over which is spread a coating of white wax, probably the nutritious part of the fruit. This was found in 70 stomachs, 30 of which contained no other food. The berries, as well as the whole plant, are highly aromatic and are eaten by many species of birds, but not by any so exclusively as by the tree swallow. They comprise 16.9 per cent of the food; and as they are eaten all the summer, a time when insects are abundant, it is evident that they form a standard article of diet and are not a makeshift for lack of better food. Of other fruits red-cedar berries (*Juniperus virginiana*) were found in 3 stomachs, rough-leaved cornel (*Cornus asperifolia*) in 4, and Virginia creeper (*Parthenocissus quinquefolia*) in 1. Seeds (2.56 per cent) complete the vegetable food, a grass seed (*Zizaniopsis miliacea*), one of the smartweeds (*Persicaria persicaria*), and an unknown seed each being found in a single stomach.

Beetles collectively total 14.39 per cent, of which the useful species amount to 0.97 per cent. Scarabæidæ, the favorites, were eaten to the extent of 5.86 per cent. They were mostly of the genus *Aphodius*, small dung beetles, which, much given to flying about early in the evening, are easily captured by the swallows. They were found in 76 stomachs, one of which contained nearly 100. Weevils, or snout beetles, were eaten to the extent of only 1.9 per cent. The species selected, however, are important. Cotton boll weevils (*Anthonomus grandis*), 45 in number, were found in 6 stomachs; *Hypera punctata*, the clover weevil, was found in 1 stomach; *Sitona hispidula*, a weevil that does great damage at times, in 10; and *S. flavescens*, another destructive species, in 2 stomachs. Others of the genus *Sitona*, not specifically identified, were found in 30 stomachs. *Tomicus pini*, an engraver beetle most destructive to pine trees, was found in 11 stomachs. Altogether weevils were found in 61 stomachs, one of which contained 68 individuals, another 40, and a third 30. Among other beetles are several forms commonly known as flea beetles. One of these, *Epitrix cucumeris*, very destructive to cucumbers, potatoes, and other vegetables, was found in 19 stomachs. Other species of similar habits, found in stomachs of tree swallows, are *Haltica foliacea* and *Phyllotreta sinuata*. In all, 43 species of



TREE SWALLOW (UPPER), ROUGH-WINGED SWALLOW (MIDDLE), AND VIOLET-GREEN SWALLOW (LOWER).

beetles were identified, of which the majority are injurious to plant life in some form.

Ants (6.37 per cent), many of which are winged forms, seem to be well relished by tree swallows. Most of them are eaten from May to October. February is the month of maximum consumption (25 per cent); but as only 4 stomachs were taken in this month, the record can not be considered representative. The great bulk of this food was taken from May to October. Hymenoptera other than ants (7.58 per cent) were taken in every month but two, March and December; and as but few stomachs were secured in these months, the omission is probably accidental. This item of food is made up of wild bees and wasps, with a large proportion of parasitic species. No domestic bees were observed.

Hemiptera, the order including widely different insects, from the little plant louse (aphid) to the large harvest fly (cicada), do not appear repugnant to birds because of their odor; in fact, the family Pentatomidæ, generally known as stinkbugs, forms a staple article of diet of most insectivorous birds. They were found in 5 stomachs of the tree swallow. Tree hoppers (Membracidæ) were found in 6 stomachs, leaf hoppers (Jassidæ) in 9, and plant lice (Aphididæ) in 11. Probably more of the last were present, but these fragile creatures are so easily reduced to a pulp that the action of the stomach soon renders them unrecognizable. The most interesting family of the Hemiptera in this connection are the Lygæidæ, found in only 3 stomachs, but in one represented by the remains of 80 chinch bugs (*Blissus leucopterus*). The bird had evidently encountered a swarm of these insects in flight and had filled up on them, an indication that they are palatable and will be taken whenever found.

Diptera form the largest item of the tree swallow's food (40.54 per cent). They were eaten all through the year, but mostly in the colder months. The greatest quantity (89.5 per cent) was taken in November and the least (6.98 per cent) in August, which is proverbially the month of flies. While numerous, they represent but few families, and only 5 were identified in the stomachs: Craneflies (Tipulidæ), horseflies (Tabanidæ), robberflies (Asilidæ), flower flies (Syrphidæ), and house flies (Muscidæ), the last of which were by far the most numerous. The syrphus flies, found in 10 stomachs, are usually considered useful insects, as many when in the larval state feed upon plant lice and others act as scavengers.

Lepidoptera were eaten only in the months from April to September, the greatest quantity in August (5.02 per cent). They were found in 20 stomachs, 15 of which contained the adult moths and 5 the larvæ, or caterpillars; an indication that the bird takes the adult insect probably because of its method of feeding—upon the wing. The average for the year is only 1.07 per cent.

Grasshoppers, found in 13 stomachs collected in the two months August and September, amount to a little more than 2 per cent in each, an average of only 0.37 per cent for the year. This indicates that the tree swallow does not seek grasshoppers, for 112 stomachs were taken in August (the grasshopper month), and even a moderate appetite for these insects would have been revealed by that number of stomachs.

Among various other orders represented in the tree swallow's food, remains of dragonflies (Odonata) were found in 25 stomachs, one of which contained fragments of 10 individuals. It has been suggested that grasshoppers are too large to be managed by such small birds as swallows, but a bird that can successfully dispose of dragonflies should have little trouble with grasshoppers. Both of these insects have harsh, crisp wings and stiff legs, while the body wall is hard and not easily crushed. Both have hard, stout jaws, which, remaining in the bird's stomach, serve to show what kind of food has been eaten. May flies (Ephemerida) were found in 11 stomachs.

Spiders (Arachnida) were found in 3 stomachs. In one a swarm of minute young ones, evidently newly hatched, constituted 99 per cent of the food. This may indicate that spiders are not distasteful, but hard to get. In one stomach was found a small piece of fishbone, an unaccountable item in the food of the tree swallow. These various items together amount to 4.64 per cent and close the food account.

Summary.—In the food of the tree, or white-bellied, swallow one point is prominent—in its vegetable food it has no relation to man. Every item is wild and of no use. In its insect diet it destroys some parasitic Hymenoptera, some carnivorous Diptera, and a few other useful insects, but this fault it has in common with most other insectivorous birds, and in common with them it is engaged in reducing the great flood of insect life to a lower level. Let it be protected and encouraged.

Following is a list of the insects identified in stomachs of tree swallows and the number of stomachs in which found:

ODONATA.	
Lestes sp	8
ORTHOPTERA.	
Tettix sp	1
HEMIPTERA.	
Stictocephalus sp	1
Blissus leucopterus	1
Pamera sp	1
Limnotrechus sp	1
COLEOPTERA.	
Clivina sp	1
Pterostichus sp	1
Amara sp	3
COLEOPTERA—continued.	
Platynus variolatus	3
Casnonia pennsylvanica	1
Agonoderus californicus	1
Discoderus robustus	1
Cnemidotus 12-punctatus	1
Bidessus affinis	1
Hydroporus sp	1
Berosus striatus	1
Helophorus lacustris	1
Helophorus sp	1
Hydrobius mathewsii	1
Sphæridium scarabæoides	5
Cercyon sp	1
Cryptopleurum minutum	1
Aleochara bimaculata	1

COLEOPTERA—continued.	
Philonthus sp	3
Stenus sp	1
Trogophlœus sp	1
Hister subrotundus	2
Hister sp	1
Saprinus pennsylvanicus	1
Conotelus sp	2
Stelidota sp	4
Omosita colon	3
Glischrochilus fasciatus	3
Monotoma picipes	1
Heterocerus undatus	1
Heterocerus sp	1
Drasterius elegans	2
Chauliognathus marginatus	1
Onthophagus hecate	1
Onthophagus pennsylvanicus	3
Onthophagus sp	4
Aphodius fimetarius	33
Aphodius ruricola	1
Aphodius vittatus	1
Aphodius inquinatus	27
Aphodius sp	14
Dichelonycha sp	2
Anomala varians	2
Strigoderma pygmæa	11
Hæmonia nigricornis	27
Exema conspersa	1
Diabrotica sp	1
Cryptocephalus venustus	1
Pachybrachys sp	1
Diachus auratus	1
Colaspis sp	1

COLEOPTERA—continued.	
Cerotoma trifurcata	4
Haltica foliacea	1
Epitrix cucumeris	19
Phyllotreta sinuata	1
Notoxus alamedæ	1
Notoxus sp	2
Anthicus sp	5
Sitona hispidula	12
Sitona flavescens	2
Sitona sp	31
Apion porcatus	2
Hypera punctata	1
Phytonomus sp	1
Anthonomus grandis	6
Orchestes vittata	1
Centrinus sp	1
Tychius sp	1
Hylastes sp	1
Rhinoncus pyrrhopus	1
Balaninus sp	12
Tomicus pini	11
Tomicus sp	2
DIPTERA.	
Eristalis tenax	1
Syrphus sp	10
HYMENOPTERA.	
Augochlora pura	1
Halictus sp	1
Lasius sp	1
Tiphia sp	2
Ophion sp	1

VIOLET-GREEN SWALLOW.

Tachycineta thalassina.

The violet-green swallow (Pl. II, lower figure) is found only on the Pacific side of the continent from the eastern slope of the Rockies to the coast. It extends as far north as Alaska in the summer, but in winter retires south beyond our borders. Its original nesting place was a hollow branch or tree trunk, but holes in cliffs and abandoned woodpecker nests also were used. The big oaks of California almost always furnish sites of this kind in exposed hollows of older branches that have died and broken off. This species has not as yet abandoned its natural nesting site for one of man's construction, although it does not avoid human society and has been known to build in a nook in a building. Also, on sunny afternoons late in summer, when the young have left the nest, hundreds of them may be seen sitting in long rows on telegraph wires preening their feathers and twittering with an air of perfect comfort.

For a study of the food of this swallow 110 stomachs were available, collected in Arizona, California, Oregon, Colorado, Wyoming, and Alaska, and in all the months from March to September. The violet-green swallow is strictly insectivorous, but bits of vegetable

matter were found in two stomachs; in one a bit of a kernel of oats, in the other a single seed of carrot. Both stomachs were taken in California in August. At that time certain species of ants may be seen harvesting the seeds of grass and other plants. It may be that a swallow picked up an ant carrying a seed and so got a bit of vegetable food, especially as these birds eat a great many ants. In any case the vegetable matter must be recorded as a mere trace, and the whole food rated as practically 100 per cent animal matter.

Beetles constitute 10.57 per cent of the food, 1.46 per cent being of useful species. The others were more or less harmful, but none have attracted attention by their depredations, although several have at times done much damage in isolated cases. In all, 24 species were identified, but none of them are familiar. The violet-green swallow has not yet come sufficiently in contact with agriculture to feed much upon the insects that destroy the farmers' crops.

Ants (9.42 per cent) were eaten from May to September. Most of them were taken in the first three months, nearly two-thirds of them in July. All of a series of six stomachs collected at Sunol, Cal., in July were completely filled with ants. Wasps and bees (17.48 per cent) are eaten in every month of the season except April. A number of parasitic species were observed, as well as a few gallflies (Cynipidæ), but no honey bees.

Hemiptera constitute the largest item of food (35.96 per cent). They are eaten in every month of the bird's stay in the North, the fewest in March, the most in September (68.36 per cent). They were selected from 12 different families, of which the Jassidæ, or leaf hoppers, were the favorites, having been found in 25 stomachs. The Capsidæ, or leaf bugs, were found in 23 stomachs, the other families in a less number. No other species of swallow has eaten so large a percentage of Hemiptera, and the value of this work can hardly be overestimated. Of the 12 families of bugs eaten by the violet-green swallow, all but 1 are plant eaters, and some, like the Jassidæ, do a great deal of damage every year; those like the Psyllidæ, the Membracidæ, and the Aphididæ are small insects but wonderfully prolific and do an immense amount of mischief without attracting attention until the harm is done. Birds that destroy these creatures are certainly doing good work.

Diptera are apparently a favorite food of the violet-green, as of other swallows. They are eaten in every month of the season, especially in the spring months, when they constitute nearly half the food. From May they gradually dwindle to less than 2 per cent in September. The total for the season is 19.36 per cent. The great mass of it was of such soft-bodied insects that in many cases it was impossible to make identifications more definitely than as to order. Craneflies (Tipulidæ) were identified in two stomachs.

No Orthoptera were found in this investigation of the food of the violet-green swallows.

Lepidoptera are eaten by this swallow to a small extent (3.12 per cent). They were taken in five months, but in only three of these do they attain even a fair percentage. Remains of small moths were found in seven stomachs and caterpillars in three.

A small mass (4.09 per cent), mostly of unidentifiable matter, was found in three or four stomachs. In two it was made out to be composed partly of Ephemeridæ, which are easily crushed.

Summary.—Little can be said of the food of the violet-green swallow. The mischief that birds do is usually through the vegetable portion of their diet. With this bird that element is eliminated at once. Whatever harm it does must be through the insects it eats. Of these the parasitic Hymenoptera are probably the most important, and only less so are the few predatory beetles and bugs it destroys. On the other hand it devours an immense number of harmful and annoying insects.

Following is a list of insects identified in stomachs of violet-green swallows, and the number of stomachs in which found:

HEMIPTERA.	
Idiocerus duzei	1
Reduviolus sp	1
Peritrechus fraternus	1
COLEOPTERA.	
Elaphrus ruscarius	1
Agonoderus pallipes	2
Bradycellus ruprestis	1
Laccobius agilis	1
Hydrobius fuscipes	1
Aleochara bimaculata	1
Aleochara sp	1
Oxypoda sp	1
Philonthus sp	1
Platystethus americanus	1
Agrilus sp	1
COLEOPTERA—continued.	
Aphodius granarius	1
Aphodius vittatus	7
Aphodius sp	3
Asemum sp	1
Hæmonia nigricornis	1
Diachus auratus	1
Haltica sp	1
Epitrix parvula	3
Epitrix sp	1
Notoxus sp	3
Anthicus punctulatus	1
Anthicus sp	1
Cantharis sp	1
Balaninus sp	1
Dendroctonus englemanni	3

BANK SWALLOW.

Riparia riparia.

The bank swallow inhabits practically the whole world, and in the United States it is more or less local, depending in the breeding season much on suitable places for nesting burrows. The nests are made by boring a nearly horizontal hole in the face of a bank of earth. In a state of nature suitable bluffs occur for the most part along the banks of streams, and it is probable that even now nine-tenths of the bank swallows in the country nest along watercourses. This species still adheres to its primitive nesting habits and does not use the structures of man, except to occupy the banks of earth exposed by his engineering operations.

The following discussion of the food of the bank swallow is based upon examination of 394 stomachs collected in the months from April to September from 21 States, the District of Columbia, and Canada. The food consisted practically of animal matter alone, but 3 small seeds were found in as many stomachs, probably taken accidentally, and these in the final analysis amounted to only 0.02 per cent of the total. The real food is made up of various insects and a few spiders.

Of insects, Coleoptera amount to 17.9 per cent, and of these 0.66 are useful species; that is, predacious ground beetles (Carabidæ) and a few ladybirds (Coccinellidæ), which devour plant lice. May beetles (Scarabæidæ) amount to 5.48 per cent. These were mostly tumblebugs or the smaller dung beetles, which, while they do no marked harm, do no special good. Fifty individuals of one species (*Aphodius inquinatus*) were found in one stomach. Snout beetles, or weevils (Rhyncophora), were eaten by the bank swallow to the extent of 5.78 per cent of its food. They occurred in 91 stomachs, in one of which 48 individuals were found, and nearly as many in several others. The rice weevil (*Calandra oryza*), so destructive to all kinds of stored grain, was found in 9 stomachs, one of which contained 40 individuals, two others 20 each, and others a less number. Cotton boll weevils (*Anthonomus grandis*), 80 in number, were found in 11 stomachs. One stomach taken in Utah contained two alfalfa weevils (*Phytonomus posticus*), insects which have done great damage in that region. One individual of the plum curculio (*Conotrachelus nenuphar*) was found in a stomach taken in New York. The genus *Sitona* contains a number of very harmful species, many of which were found in 45 stomachs. One stomach contained 26 individuals. Other beetles of a more or less harmful character amount to 5.98 per cent. Among them are several species of the well-known flea beetles, so injurious to garden truck. One of these, *Epitrix cucumeris*, was found in 10 stomachs.

Ants, most of which were winged forms, were eaten by the bank swallow to the extent of 13.39 per cent of their food. None were taken in April, but in the other months they form a large percentage of the diet. They appear to be a favorite food, having been found in 121 stomachs and forming the total contents of 11. Other Hymenoptera were found in 207 stomachs, and 6 contained no other food. As with all birds that capture their prey on the wing, the swallows take many useful parasitic Hymenoptera with the others. No honey bees were identified.

The bank swallow does not exhibit that fondness for Hemiptera shown by several other members of the swallow family. These insects aggregate for the year only 7.96 per cent, the least eaten by any of the family except the tree swallow. They were taken in every month of the season, but in rather moderate quantities, the most

in August (17.69 per cent). Leaf hoppers (Jassidæ), plant lice (Aphididæ), and tree hoppers (Membracidæ) were found in 22, 13, and 10 stomachs, respectively. These are all small insects, but they often do an immense amount of harm. Six other families of Hemiptera were identified in the stomachs, but in less quantities than the above. No special pest was discovered, but nearly all terrestrial Hemiptera are harmful.

Diptera constitute the largest element of the food of 4 of the 7 species herein discussed. With the bank swallow they form 26.63 per cent of the diet. Most of them belong to the family of the housefly (Muscidæ) and the family of the craneflies (Tipulidæ). The last are slow-flying creatures and can be easily captured by swallows, and although made up largely of wings and legs, they seem to be very acceptable food for many species of birds. Representatives of two other families were found in the stomachs.

Lepidoptera, eaten in only four months, and aggregating for the year only 1.21 per cent, are most certainly not a favorite food of the bank swallow. They were found in only five stomachs, of which three contained moths and two caterpillars. One stomach was entirely filled with caterpillars, which were probably snatched from the tops of plants as the bird dashed past.

Orthoptera were identified in the food of the bank swallow by two jaws of a grasshopper in one stomach and one jaw of a cricket in another. This low record is interesting, in view of the fact that so many birds subsist largely upon grasshoppers and allied insects.

Dragonflies (Odonata), being rather large, swift-flying insects, are not preyed upon by many species of birds; but, usually found about water, they naturally fall in the way of bank swallows and form 2.11 per cent of their food. This is not a high percentage, but is notable, as so few birds eat these insects at all. The purple martin (*Progne subis*) is the only swallow that greatly exceeds this record.

A few other insects amount to 10.53 per cent. The great bulk of these consist of May flies (Ephemerida), which are eaten freely, especially in the first of the season. They begin at 43.43 per cent in April and decrease until they finally disappear in August. A few spiders and one snail amount to 0.14 per cent. Besides the foregoing, which may be considered as food, there were found in the stomachs bits of mother of pearl (nacre), bits of eggshell, and pieces of stone, all of which must have been picked from the ground.

Included among the stomachs whose contents have been discussed were those of 28 nestlings all taken from the same colony and at approximately the same time. The food did not differ in any important respect from that of the adults, but 10 stomachs contained angular fragments of stone—not pebbles or gravel stones but broken fragments—taken from a quarry or where macadam was being

manufactured. The number in each stomach ranged from 1 to 4 or 5. For what purpose these stones were given to the nestling birds and why angular fragments were selected can only be conjectured. The food contained in the same stomachs was entirely of insects of a soft nature and did not appear to require the aid of gravel for trituration. Moreover, the parent birds, whose food was certainly as hard as that of the nestlings, did not take anything of the kind into their stomachs.

Following is a list of insects identified in stomachs of bank swallows and the number of stomachs in which found:

ISOPTERA.	
Termes sp	1
HEMIPTERA.	
Entylia concisa	6
Micrutalis calva	3
Micrutalis parva	1
Agallia sp	1
Tetigonia hieroglyphica	1
Cicadula 6-punctata	1
Tylopelta brevis	2
Lygus sp	1
COLEOPTERA.	
Bembidium versicolor	1
Bembidium sp	1
Clivina impressifrons	1
Tachys tripunctata	1
Amara sp	17
Agonoderus pallipes	1
Agonoderus sp	1
Haliplus sp	1
Bidessus affinis	2
Helophorus inquinatus	1
Hydrochus subcupreus	1
Cercyon fulvipennis	1
Cercyon melanocephalum	1
Cercyon sp	7
Cryptoplcurum minutum	5
Colon pusillum	1
Atheta sp	1
Cyrtusa blandissima	1
Homalota sp	1
Aleochara sp	2
Heterothops fasculus	1
Philonthus sp	3
Xantholinus obsidianus	1
Cilea silphoides	1
Eustilbus apicalis	1
Phalacrus politus	1
Scymnus loewii	5
Atomaria ephippiata	1
Typhœa fumata	1
Thaumatoglossa americana	1
Hister americanus	1
Hister subrotundus	2
Hister sp	2
Saprinus scissus	1
Saprinus lubricus	1
Saprinus sphæroides	1
Saprinus sp	1

COLEOPTERA—continued.	
Carpophilus dimidiatus	2
Conotelus stenoides	1
Epurœa helvola	1
Cryptarcha strigata	2
Cryptarcha sp	2
Glischrochilus fasciatus	3
Melanophthalma sp	1
Drasterius dorsalis	1
Hyperoides choris	1
Drapetes geminatus	2
Throscus sericeus	1
Cis fuscipes	1
Atœnius cognatus	1
Atœnius sp	1
Onthophagus hecate	1
Onthophagus pennsylvanicus	2
Onthophagus sp	13
Oxyomus porcatus	1
Aphodius fimetarius	6
Aphodius ruricola	1
Aphodius granarius	1
Aphodius vittatus	1
Aphodius punctatus	1
Aphodius inquinatus	24
Aphodius stercorosus	1
Aphodius sp	12
Strigoderma pygmæa	4
Hæmonia nigricornis	30
Diachus auratus	1
Graphops pubescens	1
Metachroma œneicolle	1
Cerotoma trifurcata	2
Epitrix cucumeris	10
Crepidodera helxines	1
Glyptina atriventris	2
Chætocnema pulicaria	3
Chætocnema sp	1
Mylabris prosopis (*Bruchus*)	3
Notoxus sp	5
Anthicus punctulatus	1
Anthicus floralis	1
Anthicus nitidulus	2
Anthicus sp	10
Thecesternus humeralis	1
Sitona hispidula	27
Sitona flavescens	3
Sitona sp	18
Apion metallicum	2
Apion sp	1
Phytonomus posticus	1

COLEOPTERA—continued.	
Macrops sp	1
Balaninus sp	1
Anthonomus grandis	12
Conotrachelus nenuphar	1
Cryptorhynchus bisignatus	2
Hypocœliodes wickhami	1
Cœliodes acephalus	3
Perigaster cretura	1
Limnobaris blandita	1
Baris confinis	1
Baris œrea	2
Rhinoncus pyrrhopus	1
Rhinoncus longulus	1
Centrinus picumnus	2
Calandra oryza	9
Pityophthorus minutissimus	1
Tomicus calligraphicus	1
Tomicus sp	1

COLEOPTERA—continued.	
Hylastes tenuis	1
Hylastes sp	2
Hylesinus sp	1
Brachytarsus plumbeus	1
DIPTERA.	
Culex sp	1
Calliphora sp	2
Lucilia sp	4
HYMENOPTERA.	
Chrysis sp	1
Myrmica scabrinodis	4
Pimpla sp	1
Ophion sp	1
Bassus sp	1
Rhodites sp	1

ROUGH-WINGED SWALLOW.

Stelgidopteryx serripennis.

The rough-winged swallow (Pl. II, middle figure) occupies the United States from ocean to ocean and from the Gulf of Mexico to the latitude of southern New England in the East and of southern Canada in the West. It is not abundant except locally and is found much more frequently in the more southern parts of the country. Its nesting sites are very often like those of the bank swallow; in fact, they may be the old abandoned burrows of that species; but in general they are holes in cliffs, ledges, banks, of earth, or crannies in bridges, and other structures of man. As a rule, rough-winged swallows do not dig holes for themselves. They do not live so much in large colonies as do the other species of swallows, and a pair may frequently be found breeding by themselves, though a colony of five or six pairs is more common. In migration, however, they collect in large flocks.

The following study of the food of the rough-winged swallow is based upon examination of the contents of 136 stomachs, collected in 15 States, the District of Columbia, and Canada, and in the months from April to September. The food was practically all animal matter, except that in one stomach were a lot of woody granules of uncertain origin, in another a piece of root, and in a third two seeds of currant (*Ribes*). In the final analysis these amount to 0.21 per cent and so may be dismissed without further comment. The real food is made up of insects, a few spiders, and a snail. Of the insects, 14.83 per cent are beetles, only 0.5 per cent of which are of useful species. The May-beetle family (Scarabæidæ) (2.69 per cent) were mostly the small dung beetles (*Aphodius*), with a few larger forms. Weevils or snout beetles (4.93 per cent) embrace a few interesting species, as the alfalfa weevil, found in 11 stomachs; the cotton

boll weevil, in 4 stomachs; the rice weevil, and two species of engraver beetle. Among the beetles other than weevils were a number of species of the group commonly known as flea beetles. Some of these are very destructive to garden vegetables and the leaves of fruit trees.

Ants were eaten in every month, but rather irregularly. In July they amount to 35.5 per cent and in September to 22.89 per cent, which together are about four-fifths of this kind of food for the whole season. The total for the year is 11.99 per cent. Other Hymenoptera (18.91 per cent) are eaten regularly and abundantly in every month. They contain the usual admixture of parasitic species, which being abundant are always to be found.

Hemiptera constitute 14.9 per cent of the food and are eaten regularly from May to September. None were found in stomachs taken in April, and more than four-fifths of them were taken in August and September. Ten different families are represented, but stink-bugs, tree hoppers, leaf hoppers, and negro bugs were the most numerous. All of these are more or less harmful.

Diptera are the favorite food of the rough-wing, as they are of most other swallows. They amount to 32.89 per cent, a record that is exceeded only by the tree and barn swallows. They were found in 93 stomachs, 9 of which were entirely filled with them. Flies are such soft-bodied creatures that it is not easy to determine species from the remains found in the stomachs. Five families, however, were identified. In 5 stomachs were recognized members of the family Tachinidæ, composed of parasitic species that live in and destroy caterpillars or other insects, and therefore are useful. Of the remaining four, one family is of no importance, and the others are harmful or at least annoying.

Lepidoptera are eaten sparingly by the rough-wing. The total for the year is 1.11 per cent. All were contained in 5 stomachs, 1 of which was taken in April, 2 in May, and 2 in September. Three of the 5 contained moths, and 2 caterpillars.

Orthoptera are represented in the food of the rough-wing by the fragments of one grasshopper found in a stomach taken in Arkansas on July 5. This made up 16 per cent of the contents of the stomach (0.12 per cent of the food of the year).

Insects belonging to other orders are taken occasionally by the birds. Of these, dragonflies were found in 3 stomachs and May flies in 5. In 5 other stomachs was material so finely mashed as to defy identification beyond the fact that it had once been insects. Fragments of spiders were found in 6 stomachs and a snail in 1. Altogether they amount to 5.04 per cent and close the account of animal food.

Summary.—In the food of the rough-winged swallow the useful elements are as usual in the minority. In this case they consist chiefly of parasitic Hymenoptera, the destruction of which is not a matter of great importance.

Following is a list of insects identified in stomachs of rough-winged swallows and the number of stomachs in which found:

MECOPTERA.	
Panorpa sp	1
HEMIPTERA.	
Entylia concisa	3
Thyreocoris nitiduloides	5
Thyreocoris pulicaria	1
Ophiderma sp	1
Oncometopia undata	4
Corizus sp	3
Nabis sp	1
COLEOPTERA.	
Calosoma calidum	1
Bembidium versicolor	1
Hydroporus modestus	2
Helophorus lineatus	4
Cercyon sp	1
Homalota sp	1
Alcochara bimaculata	1
Philonthus sp	5
Cryptobium sp	1
Oxytelus rugosus	1
Bledius sp	1
Olophrum obtectum	1
Phalacrus politus	1
Hippodamia 13-punctata	1
Scymnus loewii	1
Typhœa fumata	4
Hister abbreviatus	3
Hister subrotundus	4
Hister carolinus	1
Saprinus rotundatus	1
Saprinus sp	1
Carpophilus dimidiatus	1
Epuræa helvola	1
Cryptarcha strigata	4
Cryptarcha sp	1
Glischrochilus fasciatus	10
Glischrochilus sp	2
Limnichus nitidulus	1
Heterocerus sp	1
Cregya oculata	1
COLEOPTERA—continued.	
Onthophagus pennsylvanicus	5
Onthophagus sp	8
Aphodius inquinatus	18
Aphodius sp	18
Diachus auratus	1
Nodonota tristis	1
Cerotoma caminea	5
Cerotoma trifurcata	1
Galerucella sagittariæ	1
Epitrix fuscula	1
Crepidodera velutinus	1
Chætocnema denticulata	1
Chætocnema pulicaria	1
Chætocnema sp	1
Anthicus biguttulus	1
Anthicus sp	5
Rhipiphorus dimidiatus	1
Phytonomus posticus	11
Anthonomus grandis	4
Orchestes vittata	2
Rhinoncus pyrrhopus	1
Ceutorhynchus rapæ	3
Baris sp	1
Calandra oryza	1
Sphenophorus sp	2
Platypus flavicornis	1
Rhyncholus sp	1
Tomicus calligraphus	3
Tomicus cacographus	1
Hylastes tenuis	1
Hylastes exilis	1
Brachytarsus sp	1
DIPTERA.	
Bibio sp	1
Morellia micans	1
Tachina sp	5
HYMENOPTERA.	
Andrena sp	1
Lasius sp	2
Formica fusca	1

TABULAR SUMMARY.

The following table shows the relative proportions of the most important elements of the food of the seven species of swallows:

Food items.	Purple martin.	Cliff swallow.	Barn swallow.	Tree swallow.	Violet-green swallow.	Bank swallow.	Rough-winged swallow.	Average for the seven species of swallows.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Weevils	2.63	8.38	1.96	1.92	4.12	5.78	4.93	4.25
Other beetles	9.90	18.50	13.66	12.50	6.45	12.12	9.90	11.86
Ants	3.52	8.24	9.89	6.37	9.42	13.39	11.99	8.97
Other Hymenoptera	19.47	20.51	12.82	7.58	17.48	20.10	18.91	16.70
Hemiptera	14.58	26.32	15.10	5.59	35.96	7.96	14.90	17.20
Diptera	16.09	13.25	39.49	40.54	19.36	26.63	32.89	26.89
Lepidoptera	9.39	.46	2.39	1.07	3.12	1.21	1.11	2.68
Orthoptera	1.09	.71	.51	.38	.....	.01	.12	.40
Other insects	22.87	2.56	3.72	4.25	4.09	12.64	4.48	7.80
Other animal food	.46	.41	.28	.34	.....	.14	.56	.31
Vegetable food	.....	.66	.18	19.46	.....	.02	.21	2.93

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